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SE YOU WONDERED who it was that pushed Eat-More-Citrus Week (Feb. 16-21) to a successful conclusion, pictured here is one of ny conferences found necessary to spark workers throughout the State, this one in the office of Executive Vice President Harold f the State Chamber of Commerce prior to the Week's opening day. Mrs. Thelma Flanagan (seated) is outlining details of school contest designed to promote greater use of citrus, and staged by the State Department of Education. Mrs. Flanagan is the Department's lunch supervisor. Standing, (left to right) is G. F. Wilson, Mrs. Welsey Seay, Harold Colee, Mrs. Helen M. Stewart, and James E. Gor- Mr. Wilson and Mrs. Stewart represented the State Citrus Commission. Mrs. Seay is school lunch chairman of the Florida Congress of s and Teachers. Mr. Gorman is executive director of the Florida Chain Store Council.

This Month

Vol. 24, No. 3 Bartow, Florida March, 1953

What Your University of Florida Agricultural Experiment Stations Mean to You

How Men and Research Improved on Nature

$463,000,000 WORTH

Nature gave Florida a small amount of truly fertile soil, a lot of sterile sandy acres, abundant rainfall and limitless sunshine. But when it came to agricultural yields from these resources, Nature's way wasn't so profitable.

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Imagine our present vast citrus acreage without modern fertilization and pest control programs. Not until Florida's research team had learned to add nitrogen, potassium, phosphorus, zinc, iron, boron, copper, manganese and other elements could citrus be grown most successfully on sandy soils. Not until Florida's research team had developed pest control could insect pests and disease be controlled.

Imagine our pastures without the benefit of modern research. Pastures would still literally be piney woods with wide-roving scrub range cattle and razorback hogs.

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Vegetables? Research and the growers' rapid acceptance of it turned Florida's risky little vegetable industry into a $100,000,000 giant, now stabilized by adapted varieties, pest control and other research contributions.

Shade tobacco? Twice in 25 years research has saved the important cigar wrapper industry from complete ruin. The *only* successful variety now grown was bred and introduced by the University Experiment Stations.

Bulbs, peanuts, corn, dairy products—every crop of importance to Florida owes its very existence to progressive growers, conscientious service industries and the painstaking research of the University of Florida Agricultural Experiment Stations—Florida's unbeatable agricultural team that has raised Florida's farm income from only about $35,000,000 in 1900 to $498,000,000 in 1951.

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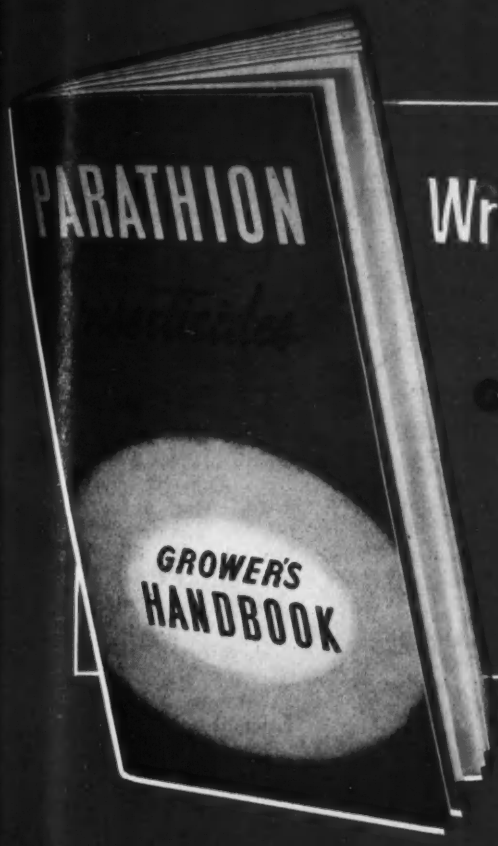

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Citrus Insect Control For March, 1953 . . .

R. M. PRATT AND W. L. THOMPSON*
CITRUS EXPERIMENT STATION,
LAKE ALFRED, FLORIDA

Purple scale activity is near the high level and the average infestation at this time is fifteen and one-half percent. This is higher than that reached at the usual peak period in July in either of the last two years. An increase in the rate of hatching is occurring, so there is ample reason to believe that this scale will be very abundant in the post-bloom period.

Hatching of red scale is increasing rapidly but the level of activity is still low. This scale is not expected to be a general problem at the post-bloom period.

Purple mite activity has been increasing since mid-January and has now reached the high level. Further increase during March is expected and this mite will probably be a problem in many groves, especially where a late dormant miticide was not applied.

Rust mite activity was unusually high during the fall and winter months. It has been declining since early December, but the level of infestation on leaves was so high at the peak that activity did not drop below the high level until the third week in February.

Six-spotted mites are being found on old foliage in numerous groves. A study of available records from past years indicates that heavy infestations with this mite may be expected to follow early cold winters. A study of weather records for last December showed that the amount of cold weather in that month was about average for seasons in which six-spotted mites have been a serious problem. The amount of cold weather in December 1952 was almost as high as that which occurred in December 1950, even though there were no major frosts this season. Furthermore, the infestations recorded in January and February of this year have increased at almost exactly the same rate as they did two years ago, when this mite became a serious problem in several areas of the State.

It therefore appears probable that six-spotted mite will be abundant on new foliage in the spring months, and that serious damage will result in many groves where it is not controlled.

This mite is most numerous in the coastal areas, especially on the West Coast, at this time, but reports have also been received from interior districts. Foliage should be checked carefully before the post-bloom spray is applied, especially where a dormant miticide was not used. If any mites are found, a miticide should be included in the post-bloom spray.

SPRAY PROGRAMS

The post-bloom spray period will probably start about the second or third week in March and will be at a peak during the latter part of the month and the first two weeks in April. Timing of applications for high quality fruit is important at this time of the year because blemishes caused by melanose, scab, rust mites, mealybugs and spray injury cannot be eliminated after the fruit has been injured.

Since economy is always a factor, a pre-spray inspection of groves should be made for scales and mites, particularly for purple scale and the six-spotted mite. The indications are that purple scale will be at a rather high level this year and also the six-spotted mite. The six-spotted mites should be controlled before many of the new leaves are infested if leaf drop is to be prevented. In groves where melanose control is practical, the copper spray should be applied as soon as possible after the petals have dropped.

The post-bloom spray program varies so much between groves that it is difficult to make recommendations except in a general way. The points to consider are including the necessary ingredients and being sure they are all compatible with each other. The 1953 Spray and Dust Schedule should be referred to for combination sprays.

Scale Control: Each year there are a number of groves that require a post-bloom scalicide and from all indications it will be necessary for many to be sprayed for purple scale control this year. Either an oil emulsion or parathion can be used during the post-bloom period. A combination of a neutral copper and an oil emulsion is an effective spray to apply for the control of melanose, purple scale, red scale and purple mites. The oil in this combination will also check a light infestation of rust mites for a few weeks. However, there are certain limitations to using an oil spray in the post-bloom period. If an oil emulsion is used on oranges it should be applied as soon as the petals have dropped or before the fruit reaches ½ inch in diameter. Oil sprays applied on oranges may cause oil blotch if applied when the fruit sizes are between ½ inch and 1½ inches in diameter. Oil sprays will also prevent any further degreening of Valencias. As is generally known, oil sprays should not be applied if the trees are suffering for moisture. In general, oil sprays can be used if not more than one or two other ingredients are used in combination with it. For instance, a copper-oil-arsenic can be used on grapefruit, but the scale control is not likely to be as satisfactory as where oil is applied without any other ingredients in it.

Parathion can be combined with most of the materials used in the post-bloom spray if the solution is not highly alkaline. It is compatible and effective when used in combinations with neutral compounds of copper zinc and manganese, as well as with arsenate of lead, molybdenum compounds, borax, wettable sulfur, and the various miticides that are on the market. Where there is a light to medium infestation of scale, one pound per 100 gallons can be used, but if there is a medium to heavy infestation, use 1 2/3 pounds. If mealybug control is necessary, parathion should be used in preference to an oil emulsion.

A combination of one pound of parathion and three quarts of oil emulsion (84 to 90 percent oil in the emulsion) is an effective spray

(Continued on page 15)

*Written February 25, 1953. Reports of surveys by Harold Holtsberg, Cocoa; J. W. Davis, Tavares; K. G. Townsend, Tampa; J. B. Weeks, Avon Park; and T. B. Hallam, Lake Alfred.

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Revaluating Palatability In Florida Citrus Fruits

PAUL L. HARDING, PRINCIPAL PLANT PHYSIOLOGIST, BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING, USDA

Between 1935 and 1949 the physical changes that occur in citrus fruits were studied intensively by the United States Department of Agriculture at Orlando, Florida, to obtain data that could be used as a basis for a practical standard for evaluating quality. The work, which was on the principal varieties of round orange (5) and grapefruit (1), on Dancy Tangerine (2), and on Temple orange, showed that palatability ratings were definitely associated with the chemical composition of the fruit. A practical method was devised for identifying fruit that would meet consumer approval by means of chemical analysis of a representative sample. Acceptable round oranges can be recognized by reference to a chart, or nomograph, which shows definite limits, or boundary lines, for total solids and total acid contents of such fruit (see fig 1).

Marked physical and chemical changes occur in the fruits during maturing and ripening. In general, appearance and certain other physical qualities of the fruits are indicative of their eating quality. But aside from the fact that individual judgment is frequently whimsical with regard to appearance, there are many exceptions to the general rule. In many instances unattractive fruit as judged by present standards actually rates higher in palatability than fruit more attractive in appearance. In these investigations emphasis was placed on palatability because, regardless of the merits of all other qualities that make for consumer appeal, the consumer's reaction to the flavor of the fruit is the ultimate test. This is true for fruit that is canned or processed in other ways, as well as for fresh fruit.

The stage of maturity, or degree of ripeness, the fruit has reached when harvesting is directly related to its palatability and is the most important factor that influences it. Other factors, such as weather conditions including rainfall and sunshine, soils, fertilizers, cultivation, pruning, spraying, and dusting, may likewise affect eating quality, but it has not been feasible to determine in what way or to what extent.

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RELATION OF MATURITY AND RIPENESS

For all practical purposes citrus fruits are mature when they attain their greatest weight. At this stage they are ripe. For convenience ripeness and maturity are considered synonymous, and that stage when the fruit reaches perfection in taste is considered as "prime." Although in a large group of tasters some variation in scoring may be expected, analysis of the results of the taste tests shows that fruit which had attained maximum weight and volume of juice, a medium-high content of total solids and at the same time a relatively low total acid content was rated the most palatable.

SAMPLES PICKED FOR TASTE TESTS AND CHEMICAL ANALYSIS

The studies on each kind of fruit usually covered a period of 4 seasons. The many groves used for fruit sampling were selected to represent the average commercial plantings in Florida. They were located in different districts and on a wide range of soil types that had low to high organic matter contents. In each of these districts the plots contained trees on both rough lemon and sour orange rootstocks.

The tests on the fruit were started about the first of September

or the first of October, depending on the kind of fruit, and continued until April or May of each season.

In obtaining fruit for study, care was taken to pick only that from the regular bloom; otherwise, the fruits for all the tests were picked at random at two- or four-week intervals from plots consisting of ten to twenty trees. Each sample consisted of 100 or more fruits. The fruit samples were taken to the laboratory at Orlando, Florida, immediately after they were picked, placed in storage at 32° to 36° F., and tested as promptly thereafter as feasible.

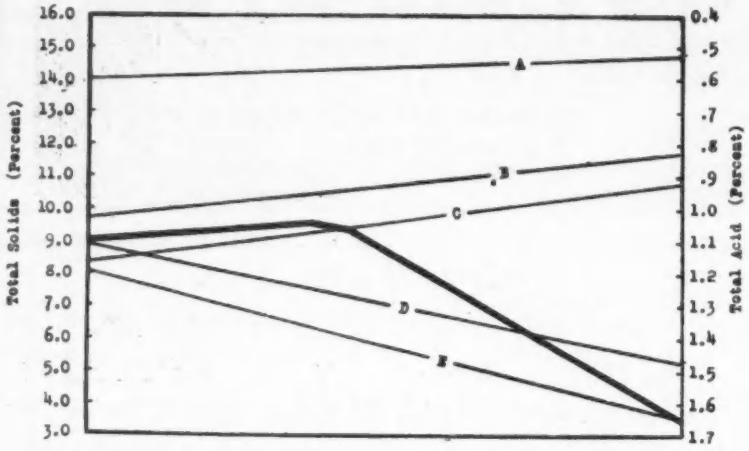

Figure 1. Nomograph illustrating the relation of consumer approval to total solids and total acid in representative samples of oranges. Fruits of different compositions that met consumer approval according to taste tests determined the position and shape of the heavy bar. Any straight line which can be drawn entirely above the heavy bar between a total solids value and an acid percentage acceptable fruit, i. e., lines drawn between 14.01 and 1.65 and 9.00 and 0.53 (lines A and B) will both represent fruit which have a combination of acceptable solids and acid, though quite different in composition. Those that cross the heavy bar or are below it at all points illustrate fruit that did not meet consumer approval. A, pleasantly tart to sweet fruit (scoring 80 to 100); B, pleasantly tart, (scoring 70 to 79); C, tart (scoring 60 to 69); D, acid (scoring 40 to 59); E, veryacid (scoring 20 to 39).

CHEMICAL ANALYSIS

Lots of 25 fruits from the samples rated for palatability were used for chemical analysis. The juice was extracted by a pressure extractor and then strained through cheescloth to remove seeds and pulp.

The analysis included, among other determinations, total solids (principally sugars) and total acid (as citric).

METHODS OF EVALUATING PALATABILITY

In these studies the eating quality of the fruit was given special attention. Taste appeal is determined by the texture of the flesh, juiciness, contents of total solids and total acid (solids-acid ratio), and aroma.

The panel of taste testers consisted of a large number of individuals, mostly staff members of the Bureau of Plant Industry, Soils, and Agricultural Engineering and of the Bureau of Entomology and Plant Quarantine, stationed at Orlando, Florida. The membership in the panels varied somewhat during each season and also from year to year. However, because absenteeism and transfer of personnel were not very great, a given panel of judges was available for the rating of the fruit under investigation. These taste judges appraised and scored each lot of fruit, and their numerical ratings were averaged. Scoring of samples was done according to arbitrary standard scales. The score card used for tangerines and Temple oranges is shown in Table 1.

Table 1. Score Card for Testing Taste or Flavor of Tangerines and Temple Oranges 1/

Arbitrary standard	Taste or flavor of fruit	Numerical rating range corresponding to description	Individual numerical rating
Very acid	Very acid, raw, immature flavor	20-39	———
Acid	Acid with absence of raw, immature flavor	40-59	———
Tart	Too tart for consumer approval	60-69	———
Pleasantly tart	Minimum stage of acceptability for consumer	70-79	———
Pleasantly tart to sweet	Pleasant blend of sugars and acid, with very good texture and flavor	80-100	———
Insipid (aged)	Very sweet, watery, lacking in flavor, low in acidity, aged	———	———

1/ This score card was used by the panel of taste testers. A rating of 70 was selected as the arbitrary standard below which the judges would consider the fruit not acceptable, or not meeting consumer approval.

The taste judges were a cosmopolitan group. All were adults. Records on the tangerine and Temple orange panels showed that the judges ranged in age from 19 to 70 years and that their average age was 38 years. For its possible bearing on taste preference, information was obtained from the members of these panels as to their birthplace and states of longest residences. The judges were born in 28 stats and in Canada, but only 1 was born in Florida. Most of the judges had resided longest in states other than the one where they were born; only about 25 per cent of them had resided longest in Florida.

At the beginning of each season the arbitrary standard scale for evaluating internal quality was discussed with the staff members who were to participate as taste judges to make sure that each one was informed as to its use. In particular, it was stressed that the numerical value of 70 would be the minimum standard of acceptability, that any fruit rated less than 70 and "tart" in flavor would be considered unpalatable, and that desirable fruit quality of pleasantly tart to sweet would be given values of 70 to 100.

In each individual test 50 to 100 fruits were used. The fruits were cut transversely, and from each half was cut a wedge-shaped piece for tasting. The judges were advised to taste several pieces of fruit before scoring the lot.

INTERRELATION OF TOTAL SOLIDS, TOTAL ACID, AND CONSUMER APPROVAL

The data from the tests were used in constructing nomographs for each kind of fruit studied. Each nomograph showed the minimum total solids and the maximum total acid content necessary to rate a

(Continued on page 16)

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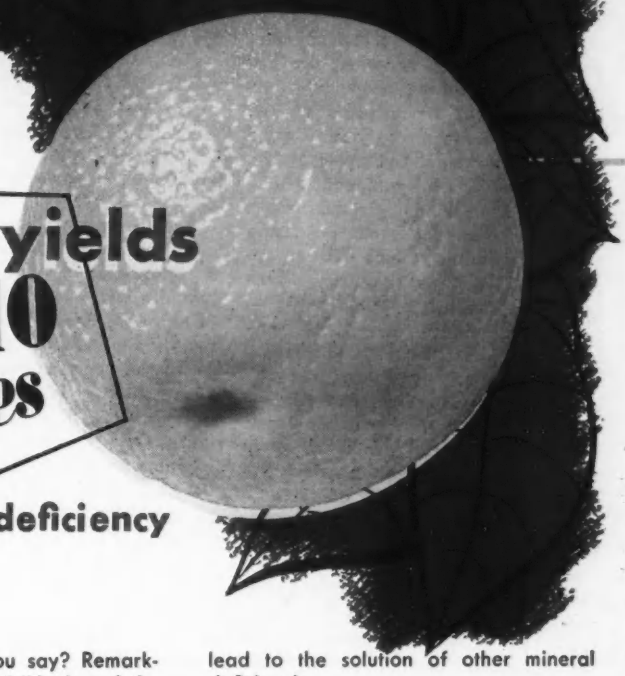

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There is much to do, much to learn. But the results to date, in the field of iron deficiency at least, are no longer merely "interesting"—they are, instead, making the hopes of the early research stand up under the exacting demands of actual field conditions.

Literature available on request: (1) technical bulletin on "Metal Complexes of Sequestrene in Plant Nutrition"; (2) pamphlet on "Iron Chlorosis in Citrus"; (3) paper by Ivan Stewart and C. D. Leonard on "Iron Chlorosis—Its Possible Causes and Control"; paper by Louis Jacobson on "Maintenance of Iron Supply in Nutrient Solutions by a Single Addition of Ferric Potassium Ethylenediamine Tetraacetate".

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Control Of Orange Decays By Pyrrolidine Alone And Mixed With 2-Aminopyridine....

J. R. WINSTON AND
G. A. MECKSTROTH

More than 2,000 chemical compounds have been screened for citrus-decay-controlling properties during the past 5 or 6 years at the Orlando laboratory of the United States Department of Agriculture. Several effective compounds discovered are being given further trials. Those that seem promising in the preliminary tests will be reported as soon as they have been tested sufficiently. Obviously, to be commercially acceptable any compound must be 1) readily available and relatively cheap; 2) capable of effecting a high degree of decay control when the fruit is held for several weeks at room temperature; 3) non-injurious to appearance or flavor of treated fruit; and 4) non-toxic to warm-blooded animals when ingested in small quantities over a long period. In the past 8 or 10 years, several decay inhibitors or mixtures of chemicals meeting these requirements have been reported by state or federal workers. The most promising of these are 2-aminopyridine and the Dowicide A (sodium-ortho-phenylphenate) plus hexamine mixture.

Senior horticulturist and associate pathologist respectively, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, Orlando, Florida, at meeting Florida State Horticultural Society.

Screening tests conducted in January 1950 showed that pyrrolidine, a water-soluble slowly volatile compound, was sufficiently effective in checking decay in gassed oranges to warrant further investigations. Tests on a semi-commercial scale with both non-gassed and gassed oranges and later tests with still larger lots of fruit in commercial packinghouses confirmed the preliminary findings.

LABORATORY TESTS

The test oranges in lots of approximately 50 each were selected from various full-bearing groves in central Florida where both kinds of stem-end rot and green mold (penicillium) rot were abundant in season. Tests were made in winter when green mold is most active as well as late in the spring when phomopsis stem-end rot is the principal decay. In some instances the test fruit was subjected to ethylene gas for 40 to 60 hours, simulating the exposures in commercial houses and thus predisposing the fruit to rapid spoilage when the diplodia stem-end rot fungus is present. The fruit was washed and then dipped for 2 minutes in the diluted fungicide, dried without rinsing and stored for 3 weeks in a room held at 70°F. Inspections for decay were made at the end of each week of the holding period and for chemically induced rind injury at the first and second inspections only. After the first 2 weeks natural breakdowns masked those chemically induced.

Comparison of concentrations. In January 1951 in 6 tests with non-gassed and 20 with gassed overripe, early fruit, 1.25, 2.5 and 5 percent concentrations of pyrrolidine were tried. In the non-gassed check fruit (Table 1) the average loss from decay at the end of the first, the second and the third week was 13, 31 and 56 percent, respectively. Green mold was responsible for all of the loss at the first inspection and for more than half of it at the final inspection. Although the lighter concentration of pyrrolidine reduced decay somewhat, the heaviest concentration was the most effective. After 3 weeks, there was approximately

TABLE 1

DECAY IN NON-GASSED EARLY ORANGES (JAN. 1951) AND THOSE TREATED WITH ETHYLENE (DEC. 1951) BEFORE BEING DIPPED 2 MINUTES IN PYROLIDINE OF VARIOUS CONCENTRATIONS IN WATER, ORLANDO, FLORIDA

(Each value (round number(average of 6 tests for non-gassed and of 20 tests for gassed fruit; tr = less than 1 percent)

Period at 70°F. and treatment	Non-gassed fruits					Gassed fruits				
	Total dipped Number	Total decay Percent	Stem-end rot Percent	Green mold rot Percent	Miscellaneous rots Percent	Total dipped Number	Total decay Percent	Stem-end rot Percent	Green mold rot Percent	Miscellaneous rots Percent
1 week:										
None (water check)	245	13	0	13	0	874	11	1	10	0
1.25 percent	245	4	tr	3	0	832	7	tr	6	0
2.5 percent	251	2	0	2	0	874	5	tr	5	0
5 percent	250	tr	tr	tr	0	871	3	tr	3	0
2 weeks:										
None (water check)	245	31	4	27	0	874	35	20	15	0
1.25 percent	245	15	5	9	tr	832	21	11	10	tr
2.5 percent	251	14	3	9	2	874	17	8	9	tr
5 percent	250	7	3	2	2	871	12	7	5	tr
3 weeks:										
None (water check)	245	56	23	33	tr	874	51	33	18	0
1.25 percent	245	35	18	15	2	832	31	18	12	tr
2.5 percent	251	30	12	15	3	874	26	14	12	tr
5 percent	250	21	11	5	5	871	20	12	7	tr

twice as much stem-end rot and seven times as much green mold in the untreated fruit as in that treated with 5 percent pyrrolidine. In the gassed check fruit (Table 1) similar trends were noted; i.e., the least reduction in decay was found in the fruit treated with the weakest concentration of pyrrolidine and the greatest reduction in that treated with the strongest concentration.

Comparison of treating-solution at different temperatures. In 3 tests made with both non-gassed and gassed over-ripe, early oranges during January 1952 (Table 2) the effects of treating-solution temperatures in the range common in commercial operations (70°, 100° and 125°F.) were compared. The treated fruit were dipped in a 5 percent pyrrolidine solution at each of the temperatures and the check lots of fruit were subjected to a water bath at corresponding temperatures. Decay was not reduced consistently by raising the temperature of either the treating solution or water bath from 70° to 125°. There were approximately 14, 35 and 45 percent decay in the check fruit at 70° at the first, second and third inspections. Green mold caused practically all the decay at the first inspection, about 2/3 at the second and about half at the third. Pyrrolidine reduced both stem-end rot and green mold at each inspection. It was effective on non-gassed fruit at least during the first 2 weeks than in fruit subjected to ethylene. A mixture of hexamine and pyrrolidine caused severe rind injury at all temperatures and did not increase decay control.

Comparison of 2-aminopyridine and pyrrolidine and mixtures of the two. Seven tests made with gassed Valencia oranges in the spring of 1952 compared 5 percent concentrations of 2-aminopyridine and pyrrolidine with a 5 percent solution of equal parts of these compounds (Table 3, Group A).

The decay losses from all causes in the check lots were 5, 22 and 38 percent at the end of the first, the second and the third week, respectively. Stem-end rot was responsible for less than half of the decay at the first inspection and approximately 4/5 at the last inspection. Pyrrolidine gave the least control of decay, whereas a mixture of 2-aminopyridine and pyrrolidine gave the greatest control. Treatment with 2-aminopyridine alone and a mixture of 2-aminopyridine and pyrrolidine gave complete control of stem-end rot during the 3-week holding period.

Comparison of Dowicide A + hexamine and 2-aminopyridine + pyrrolidine. In 9 tests with gassed Valencia oranges a 2 percent Dowicide A + 1 percent hexamine bath was compared with a 5 percent solution of equal parts of 2-aminopyridine and pyrrolidine (Table 3, Group B). There were 6, 29 and 42 percent total decay in the untreated lots at the first, the second and the third inspection respectively. Stem-end rot accounted for practically all of the decay at each inspection. At the first inspection the 2 mixtures were about equally effective; at the second and third inspections the mixture containing

Table 2. Rind breakdown and decay in non-gassed and gassed early over-ripe oranges treated with 5 percent pyrrolidine with and without an equal part of 2.5 percent hexamine at different temperatures, January 1952, Orlando, Florida.

(Each value (round number) average of 3 tests; tr = less than 1 percent)

Period at 70°F. and treatment	Non-gassed fruit							Gassed fruit					
	Temperature of dip	Total treated Number	Rind breakdown Percent	Total decay Percent	Stem end rot Percent	Green mold rot Percent	Miscellaneous rots Percent	Total treated Number	Rind breakdown Percent	Total decay Percent	Stem end rot Percent	Green mold rot Percent	Miscellaneous rots Percent
1 week:													
None (water check)	70°	149	0	14	1	13	0	151	0	15	1	14	0
	100°	147	0	18	1	16	0	150	0	17	3	14	0
	125°	150	0	13	1	11	0	150	0	6	0	6	0
Pyrrolidine	70°	150	0	1	0	1	0	150	0	6	tr	5	0
	100°	149	5	tr	0	tr	0	151	0	5	0	5	0
	125°	150	86	1	0	1	0	149	87	5	0	5	0
Pyrrolidine + hexamine	70°	150	15	2	tr	1	0	151	31	3	0	3	0
	100°	150	55	tr	0	tr	0	150	23	3	tr	3	0
	125°	150	99	tr	0	tr	0	150	79	3	1	tr	1
2 weeks:													
None (water check)	70°	149	0	35	14	20	tr	151	0	34	13	21	0
	100°	147	0	37	11	27	0	150	0	32	12	20	0
	125°	150	0	35	12	23	0	150	0	18	9	9	0
Pyrrolidine	70°	150	0	8	3	5	0	150	0	12	5	7	0
	100°	150	4	7	2	5	0	151	0	12	3	9	0
	125°	150	85	4	0	3	1	149	81	12	5	7	0
Pyrrolidine + hexamine	70°	150	25	11	3	7	1	151	28	9	2	6	1
	100°	150	59	7	2	4	tr	150	29	7	2	5	0
	125°	150	94	6	4	1	tr	150	74	15	9	3	2
3 weeks: 1/													
None (water check)	70°	149	—	45	20	25	tr	151	—	44	21	23	0
	100°	147	—	50	19	31	0	150	—	48	23	24	tr
	125°	150	—	45	19	26	tr	150	—	35	23	11	0
Pyrrolidine	70°	150	—	13	5	7	0	150	—	19	9	10	0
	100°	149	—	17	6	11	0	151	—	17	4	12	tr
	125°	150	—	11	3	5	2	149	—	19	10	9	0
Pyrrolidine + hexamine	70°	150	—	19	6	10	3	151	—	22	9	11	3
	100°	150	—	20	11	7	2	150	—	13	6	6	1
	125°	150	—	13	8	3	1	150	—	24	15	5	3

1/ No record was kept on rind breakdown at final (3-week) inspection.

pyrrolidine was decidedly more effective. After 3 weeks there was about 3 times as much decay in the untreated fruit as in that treated with Dowicide A mixture and 6 times as much as in that treated with the pyrrolidine mixture. During these experiments taste tests made periodically with treated fruit showed that none of the compounds injured the taste of the fruit.

PACKINGHOUSE TESTS

In January and February when green mold was active, 10 tests were made in packinghouses on box-size lots of full-ripe, non-gassed midseason oranges. Again in late May, 6 tests were made with gassed Valencia oranges that were so weak that definite symptoms of stem-end rot were visible at the end of the passing period. All fruit received the usual washing, drying and waxing treatments given in commercial operations. Solvent wax was used at 3 packinghouses and water-wax emulsion at the other. The treated lots except those given the commercial Dowicide A + hexamine treatment were removed from the conveyors as they emerged from the washer, dipped for 10 to 15 seconds in a small tank containing a solution of the decay inhibitor being tested and placed again on the conveyor leading to the drier. In the winter tests, 5 percent 2-aminopyridine was compared with 5 percent pyrrolidine at 1 packinghouse. A few days later, these 2 compounds were compared with commercially applied 2 percent Dowicide A + 1 percent hexamine mixture at another house.

The untreated fruit from the first house (Table 4, packinghouse 1), where 4 tests were made, had 21, 34 and 50 percent total decay, with green mold causing almost all the decay at the first inspection, approximately 6/7 at the second and 3/4 at the third; 2-aminopyridine gave almost complete control of stem-end rot but was not as effective against green mold as pyrrolidine. There was 5 times as much green mold in the pyridine-treated fruit at the first inspection as in the pyrrolidine-treated and about 3 times as much at the second and third inspections.

The untreated fruit from the second packinghouse (Table 4, packinghouse 2), where 6 tests were made, had 16, 39 and 58 percent total decay; 2 amino-pyridine again gave better control of stem-end rot while pyrrolidine was more effective against green mold. The Dowicide A + hexamine mixture was almost as effective against stem-end rot as pyrrolidine but not as effective against green mold.

The 6 tests in May were made in 2 commercial packinghouses (Table 4, packinghouses 3 and 4), where the commercially applied Dowicide A + hexamine mixture was compared with a mixture of equal parts of 2-aminopyridine and pyrrolidine (5 percent active ingredients).

There were 12, 43 and 56 percent total decay at the first, the second and the third inspection, respectively, in the check lots. Practically all of the decay was caused by stem-end rot. The 2-aminopyridine + pyrrolidine mixture gave greater control of decay at each of the 3 inspections. At the first inspection the difference in control between the Dowicide A mixture and the 2-aminopyridine + pyrrolidine mixture was not great; at the second and third inspections the Dowicide A + hexamine treated fruit had 2 and more than 3 times as much decay, respectively, as that treated with the 2-aminopyridine + pyrrolidine mixture.

DISCUSSION

Tests were made in mid-winter and early summer with both gassed and non-gassed, over-ripe fruit to give the chemicals a severe trial. Those with pyrrolidine indicate that it is more effective in the

(Continued on page 15)

RIND BREAKDOWN AND DECAY IN GASSED VALENCIA ORANGES TREATED WITH SEVERAL DECAY INHIBITORS SPRING 1952, ORLANDO, FLORIDA

(Each value (round number) in Group A average of 7 tests; Group B average of 9 tests; tr = less than 1 percent)

Period at 70°F and treatment	Total tested Number	Rind breakdown Percent	Total decays Percent	Stem-end rot Percent	Green mold rot Percent	Miscellaneous rots Percent
Group A						
1 week:						
None (water check)	352	0	5	2	3	0
5 percent 2-amino pyridine	354	0	2	0	2	0
5 percent pyrrolidine	355	0	1	0	tr	0
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	352	0	1	0	tr	0
2 weeks:						
None (water check)	352	0	22	17	5	tr
5 percent 2-amino pyridine	354	0	4	0	3	tr
5 percent pyrrolidine	355	0	7	5	2	0
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	352	0	1	0	1	0
3 weeks:						
None (water check:	352	—	38	32	6	tr
5 percent 2-aminopyridine	354	—	6	0	6	tr
5 percent pyrrolidine	355	—	17	14	3	0
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	352	—	2	0	2	0
Group B						
1 week:						
None (water check)	478	0	6	5	tr	tr
2 percent Dowicide A + 1 percent hexamine	474	0	2	2	0	0
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	487	0	3	2	tr	tr
2 weeks:						
None (water check)	478	0	29	27	tr	1
2 percent Dowicide A + 1 percent hexamine	474	5	7	6	tr	tr
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	487	0	4	3	tr	tr
3 weeks:						
None (water check)	478	—	42	37	3	2
2 percent Dowicide A + 1 percent hexamine	474	—	13	11	tr	2
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	487	—	7	3	3	2

The Cause Of Yellow Tipping In Citrus Leaves[1]

IVAN STEWART AND
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FLORIDA CITRUS EXPERIMENT
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Yellow tipping of citrus leaves has been observed in Florida for over 20 years. This investigation has disclosed that the trouble is caused by perchlorates that occur as impurities in fertilizers. The symptom of this toxicity shows up first as a bright yellow-orange color on the tip of leaves. As the condition becomes worse the orange color may spread over the entire tip half of the leaves (Fig. 1). The leaf veins usually remain green and only in advanced stages do they become chlorotic. In severe cases the trees partially defoliate.

Yellow tipping is often confused with boron toxicity. In both instances the leaf tips are first to be affected. However, trees that have taken up excess boron usually but not always show gumming on the lower leaf surfaces and the chlorosis is usually a dull yellow color. It is believed that yellow tipping shows up first on the parts of trees most exposed to the sun. This accounts for the fact that the yellow leaves are always found first in the outer exposed rows and in the tops of the trees in thick groves. The chlorosis generally shows up only on the upper leaf surface; however, if the leaves are turned over then the bottom surface, exposed to the sun, will show yellowing.

In 1932 Haas (2) published photographs of orange and lemon leaves with symptoms resembling yellow tip. The leaves were collected from California groves that had received large applications of calurea. The only known mention in the literature of yellow tipping in Florida citrus was a photograph published by Bryan (1) and called unidentified leaf symptoms. He reported that the leaf condition was somewhat similar to the symptoms of boron toxicity, and was thought to be associated with excess boron in certain fertilizers. It was pointed out, however, that this assumption had no experimental proof.

At the Citrus Experiment Station, Lake Alfred, chemical analyses made on leaves having yellow tipping were compared with those from trees showing boron toxicity (Table 1). The highest amount of boron found in the yellow tip leaves was 49.0 ppm. This is considerably below the level found in leaves showing boron toxicity.

In Florida, yellow tipping has been associated with the use of natural nitrate of potash derived from Chilean sources. The symptoms have not been reported in groves that have used the synthetic salt. When studies were started on this problem, applications of 22 pounds of nitrate of potash were made to single trees. In approximately three months yellow tipping was prevalent in the leaves. From the observations made it was concluded that a toxic substance must be present in the fertilizer. A study of a commercial chemical analysis disclosed that the fertilizer contained halogenates — chlorates, perchlorates and iodates. Applications of each of these were made as soil treatments to healthy grapefruit trees. Approximately one month later trees receiving chemically pure potassium perchlorate (KC10/4 showed symptoms similar to yellow tipping. Applications of 1, ½, and ¼ pounds of potassium perchlorate were then made to grapefruit trees and in addition equivalent amounts of perchlorates were applied to other trees in the form of the calcium and sodium salts. Seven pounds of nitrogen (N) was applied to each tree in the form of ammonium nitrate.

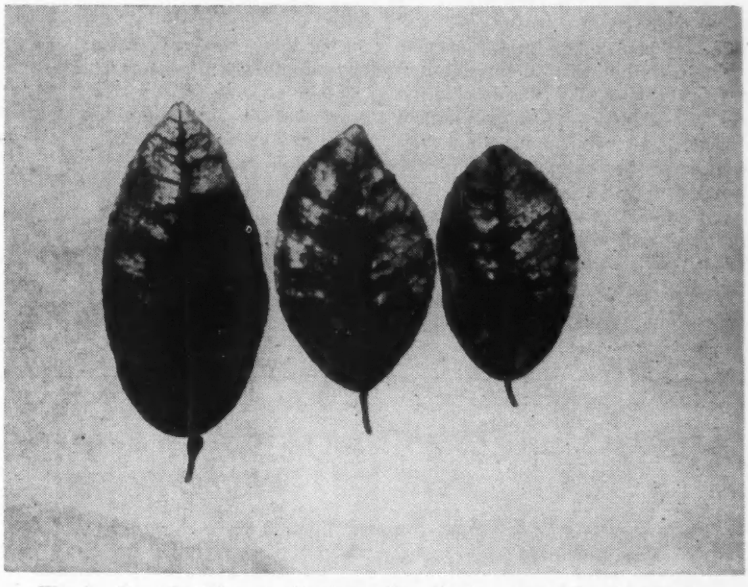

Fig. 1. Grapefruit leaves showing yellow tipping caused by perchlorate impurities in fertilizer.

The trees receiving the highest rates of perchlorates showed yellow tipping in approximately one month while those that received the intermediate and low rates showed yellow leaves in two and three months, respectively, following the application. Trees treated at the same time with 50 pounds of natural nitrate of potash had symptoms of about the same severity as those that had received the ½ pound application of potassium perchlorate. In every way the symptoms appeared identical.

Perchlorate toxicity symptoms

1. Presented before the Sixty-fifth Annual Meeting of the Florida State Horticultural Society, November, 1952.

were more severe in the absence of nitrogenous fertilizer. Trees treated with one pound of potassium perchlorate without the addition of nitrogen developed yellow tipping and later the entire leaves became copper color and severe defoliation followed. Nitrates apparently have an inhibiting effect on the action of perchlorates in plants. This inhibition of perchlorate toxicity by nitrates has also been observed in Germany (3) on field crops.

Table 1

Boron Content of Grapefruit Leaves from Trees Showing Boron Toxicity Symptoms and from Trees Showing Yellow Tipping.

Degree of Symptoms	Boron ppm.
Slight Boron Toxicity Symptoms	159.0
Slight Boron Toxicity Symptoms	135.9
Moderate Boron Toxicity Symptoms	290.0
Severe Boron Toxicity Symptoms	675.0
Severe Boron Toxicity Symptoms	510.0
No Boron Toxicity Symptoms	62.5
Slight Yellow Tipping	12.5
Moderate Yellow Tipping	49.0
Moderate Yellow Tipping	27.5
Severe Yellow Tipping	10.0

Chemical analyses for perchlorates were made on the leaves. It was found necessary to develop a new procedure for this determination. Tests showed that when chlorine was supplied to trees as sodium chloride or sodium chlorate, chloride could be extracted from the dry leaves with hot water. This indicated that the sodium chlorate was reduced either before it entered the trees or within the tree itself. However, perchlorates are more stable than chlorates and the only common procedure for reducing them to chlorates is with heat. Indications are that the perchlorate ion is not reduced but is taken up by the plant per se.

Table 2

Perchlorate Content of Grapefruit Leaves Taken from Trees Treated with Nitrate of Potash, Sodium Chlorate, and Perchlorate Salts.

Salt Applied	Amount of Salt* Applied per Tree (Pounds)	Position Sample Taken From Trees	C104- mgm./gm. Dry Wt.
KC104	1.00	Top	2.15
KC104	1.00	Bottom	1.78
KC104	.50	Top	2.54
KC104	.50	Bottom	1.32
KC104	.25	Top	1.37
KC104	.25	Bottom	1.23
NaC104	.88	Top	5.10
NaC104	.88	Bottom	2.85
NaC104	.44	Top	4.12
NaC104	.44	Bottom	2.83
NaC104	.22	Top	2.13
NaC104	.22	Bottom	1.02
Ca(C104)2	.86	Top	4.57
Ca(C104)2	.86	Bottom	2.54
Ca(C104)2	.43	Top	6.14
Ca(C104)2	.43	Bottom	1.70
Ca(C104)2	.23	Top	.85
Ca(C104)2	.23	Bottom	1.04
NaC103	1.00	Top	0.00
NaC103	1.00	Bottom	0.00
KNO3	25.00	Top	2.13
KNO3	25.00	Bottom	1.98

*Equivalent amounts of C104- was applied in the K, Na, and Ca salts at the comparative rates. The high, medium, and low rates contained 0.72, 0.36 and 0.18 pounds of C104- respectively.

Leaf samples were collected from trees that had received soil treatments of perchlorates. The highest amounts of perchlorates were found in leaves from trees that had received the higher soil applications, and the amount found in the leaves was correlated with the leaf symptoms. Leaves taken from the tops of trees where the toxicity was severe contained higher concentrations of perchlorates than those collected from the lower limbs where very little yellow tipping was found (Table 2). The symptoms were much more severe on trees that received sodium perchlorate than on trees receiving the calcium or potassium salts. Leaves from the old flush contained almost twice as much perchlorates as leaves from the new flush (Table 3). This is in agreement with the leaf symptoms in that yellow tipping can be found on the old leaves first. Since the chlorosis is almost always present on the tips of leaves and usually absent on the basal half, chemical analyses were made on the tip one-third of affected leaves and compared with the base one-third. The perchlorate content in the tips was over five times that found in the base.

A sand culture study was made to observe the effect of different concentrations of perchlorate on citrus seedlings. Three seedlings each of sweet orange, grapefruit, and Cleopatra mandarin were put in pots and given one liter of nutrient solution daily containing 0, 5, 10, 20, 50, 75, and 100 ppm. C104- supplied as NaC104. In less than one month the grapefruit seedlings receiveing 100 ppm. C104- showed extensive yellow tipping. One leaf on a sweet orange seedling showed a yellow pattern. The leaves on the Cleopatra did not show any yellow tipping but the leaf tips became burned and turned black. The growth was reduced in all the seedlings at the higest perchlorate rate. Two months after the experiment was started grapefruit seedlings in pots given rates of 20 ppm. and over showed yellow tipping. The sweet orange and Cleopatra seedlings developed toxicity symptoms only at the highest rate. This experiment would tend to confirm observations that varieties may differ in sensitivity to perchlorates.

Table 3

Perchlorate Content of Grapefruit Leaves from New and Old Flush and of the Leaf Tips and Base.

	C104- Mgm./gm. (Dry Wt.)
New Flush	1.28
Old Flush	2.56
Leaf Tips (Yellow)	3.71
Leaf Base (Green)	0.69

Table 4

Perchlorate Content of Nitrate of Potash and Nitrate of Soda from Natural Sources.

Sample	Fertilizer	C104-* percent
1	KNO3	0.58
2	KNO3	0.51
3	KNO3	0.66
4	NaNO3	0.00

*The C104- content actually includes all of the halogenates. However, field tests indicate that practically all of the halogenates found are perchlorates.

It has been known more than 50 years that Chile caliche from which natural nitrate fertilizers are derived contains up to seven percent potassium perchlorate (5). Considerable trouble developed in Europe on field crops from using sodium nitrate that contained perchlorates as impurities. It was observed (4) that sodium nitrate did not cause injury to field crops when less than one percent perchlorates were present. The test used in this study was not sensitiev enough to detect any perchlorates in the natural sodium ni-

trate now being produced. However, chemical analyses made on samples from current production of natural nitrate of potash showed that it contains more than 0.5 percent halogenates (Table 4). Field studies indicate that practically all of the halogenates found are perchlorates. The amounts present are enough to cause yellow tipping in citrus when sufficiently large applications of nitrate of potash are made. It is understood that, on the basis of this work, steps have been taken to lower the concentration of perchlorates in natural nitrate of potash.

SUMMARY

Yellow tipping of citrus leaves, which has been observed in Florida groves for many years, has been found to be caused by perchlorate toxicity. Yellow tipping was produced with soil applications of nitrate of potash derived from Chile caliche, which contains perchlorates, and with chemically pure potassium, calcium, and sodium perchlorates. Chemical analysis of leaves from trees treated with perchlorates showed that these salts are taken up in the oxidized state by the trees. A higher concentration of perchlorates was found in leaves from the tops of trees than in leaves from the bottom branches. Grapefruit seedlings grown in sand cultures were found to be much more sensitive to perchlorate toxicity than either Cleopatra mandarin or sweet orange. Chemical analysis of nitrate of potash fertilizers showed the halogenate content to be over 0.5 percent, most of which is believed to be perchlorates.

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Fig. 1. Grapefruit leaves showing yellow tipping caused by perchlorate impurities in fertilizer.

REVISED STANDARDS FOR CALIFORNIA AND ARIZONA ORANGES ANNOUNCED

Revised standards for California and Arizona oranges were announced today by the U. S. Department of Agriculture in a move to make the standards more practical in application. They will become effective March 8, 1953.

The revised standards provide that only medium or large scale (insect damage on the skin) will be considered in determining damage, and any scale within a circle 5/8 of an inch in diameter centered at the stem button or button socket will not be considered. Present standards require consideration of any scale of any size or location on the fruit. The new standards also would provide a tolerance for oranges which are not fairly well wrapped and would change some definitions for the sake of clarity.

Progress As A Problem In The Marketing of Horticultural Products

(Concluded from last issue)

Are processors able to move their products to consumers so much more economically than those who market fresh products? Or, are those in the fresh industry too much bound by outmoded methods?

One point seems clear to me in this connection: No amount of merchandising can completely compensate for a price that is too high at the retail level. This simply means that efficiency and economy in handling and distribution are always factors to be reckoned with, for costs to the industry represent prices to the consumer. And, to my notion, the best way to eliminate a cost is not to let it happen. We live in the machine age, and the age of the efficiency expert. Has the horticultural industry taken full advantage of the opportunities offered by the machine and the expert to cut labor costs and increase the efficiency of its operations? Can the spread between producer and consumer be reduced by talk or must there be action?

I believe that action is the only course to follow, and I believe that the line of action that must be followed is one which will increase the efficiency of producers, shippers, wholesalers, and retailers. In short, fruits and vegetables must be placed before the consumer at a price that will enable them to meet the competition.

Many industries have made use of time and motion studies to ascertain how work may be done with the least expenditure of labor. Only recently has activity along these lines begun in the field of agriculture. We hear reports of farmers on family farms performing their daily chores with one-third less effort and reducing the distance traveled by a similar amount. We enjoy the benefits resulting from this activity in most of the manufacturing industries. We feel the effect in the form of increased competition, too.

Many individuals in the fruit and vegetable industry have developed techniques that facilitate more efficient performance of their work. But most of those who make up the industry are not efficiency experts, and they have done their jobs in the same way for so long that they cannot see where changes might be made. However, there are individuals trained in this field, and the industry needs to take advantage of the opportunity offered by making use of their services.

Remarks by S. R. Smith
Director, Fruit and Vegetable Branch, Production and Marketing Administration, USDA, At Meeting Florida State Horticultural Society

Progress in the fruit and vegetable industry has been so rapid that in many instances facilities and equipment for handling the industry's products have been outgrown. One notable example of this is to be found in our terminal markets. The amount of wasted time and lost motion that takes place there because of inadequate facilities is as appalling as it is costly. Growers and shippers need to stir themselves into efforts to secure modernization.

Also, has as much as possible been done to reduce high transportation costs? It was progress when the production of fruits and vegetables moved to the areas most favorable for their production. But has any progress really been made if the natural advantages of climate and soil are offset by the cost of transporting the products back to the consumer? Can the industry through better packaging methods, reduction of bulk, and more efficient transportation more nearly enjoy the fruits of its labors? I think it can—with determination and action.

In my talk I have dwelt mainly upon the problems associated with progress in the fresh industry. That does not discount the problems facing processors. Here in Florida, we know that your citrus juice canners are faced with many problems difficult of solution. The rapid development of concentrate has intensified problems associated with costs and quality loss in the canned product during processing and distribution.

We know that processors of concentrate, too, are faced with problems inherent in rapid expansion and quality control. Only adequate research and the practical application of results can continue the rapid progress that has marked the development of this new Florida industry.

It was a great temptation to spend more of my time in praise of your unparalleled accomplishments that have helped to make it possible for this country to provide an ever-increasing standard of living for greater and greater numbers of people. But, on second thought, it seemed to me that though we may marvel at this, we should not spend too much time in gazing backward or in patting ourselves on the back over the wonderful job we have done. We must, like our Pilgrim Fathers, thank the Divine Providence for our blessings and get about the business of insuring our future.

That kind of insurance requires that we take heed of past, present, and future developments. It is only by so doing that we can continue the progress that has marked our history. We must examine and re-examine the developments that have contributed to our progress. And we must not fail to appraise correctly the new problems that our progress has raised. These we must cope with—successfully and without delay—if we are to maintain our reputation as the world's most progressive people.

CONTROL OF ORANGE DECAYS BY PYRROLIDINE ALONE AND MIXED WITH 2-AMINOPYRIDINE

(Continued from page 10)

control of green mold than is 2-aminopyridine, while the reverse is true of stem-end rot. The mixture of equal parts of pyrrolidine and 2-aminopyridine appears to be more effective than either used separately. The Dowicide A + hexamine mixture tends to lose its toxic effects of these chemicals on warm-blooded animals. Doubtless, commercial usage of pyrrolidine alone or in combination with 2-aminopyridine will bring to light weaknesses of desirable features thus far undiscovered. Proportions or concentrations of the chemicals and the length of exposures may be subject to change; for example, there is the possibility that they may be used in combination with

DEVELOPMENT OF DECAY IN NON-GASSED MIDSEASON AND GASSED VALENCIA ORANGES TREATED WITH SEVERAL CHEMICAL INHIBITORS IN COMMERCIAL PACKINGHOUSES, JANUARY, FEBRUARY AND MAY 1952

Each value (round number) average of 4 tests at packinghouse 1 and 6 tests at packinghouses 2, 3 and 4; tr = less than 1 percent

Packinghouse period at 70°F., and treatment	Total decays	Stem-end rot	Green mold rot
Packinghouse 1 (Non-gassed Fruit)	Percent	Percent	Percent
1 week:			
None (water check)	21	tr	21
5 percent 2-aminopyridine	15	0	15
5 percent pyrrolidine	3	tr	3
2 weeks:			
None (water check)	34	5	29
5 percent 2-aminopyridine	23	0	23
5 percent pyrrolidine	10	2	7
3 weeks:			
None (water check)	50	13	36
5 percent 2-aminopyridine	48	tr	47
5 percent pyrrolidine	26	8	16
Packinghouse 2 (Non-gassed Fruit)			
1 week:			
None (water check)	16	3	13
5 percent 2-aminopyridine	7	tr	7
5 percent pyrrolidine	5	2	3
2 percent Dowicide A + 1 percent hexamine	7	1	5
2 weeks:			
None (water check)	39	20	20
5 percent 2-aminopyridine	20	tr	19
5 percent pyrrolidine	25	15	9
2 percent Dowicide A + 1 percent hexamine	29	13	16
3 weeks:			
None (water check)	58	29	29
5 percent 2-aminopyridine	33	2	30
5 percent pyrrolidine	39	22	17
2 percent Dowicide A + 1 percent hexamine	47	25	21
Packinghouses 3 and 4 (Gassed Fruit)			
1 week:			
None (water check)	12	11	tr
2 percent Dowicide A + 1 percent hexamine	7	7	tr
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	5	5	0
2 weeks:			
None (water check)	43	41	1
2 percent Dowicide A + 1 percent hexamine	16	15	tr
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	8	7	tr
3 weeks:			
None (water check)	56	52	2
2 percent Dowicide A + 1 percent hexamine	41	37	tr
2.5 percent 2-aminopyridine + 2.5 pyrrolidine	12	8	tr

effectiveness against stem-end rot after the fruit has been held for 2 weeks at room temperature. At lower temperatures a longer period of protection against stem-end rot may be expected.

Tests with pyrrolidine alone and with mixtures of pyrrolidine and 2-aminopyridine have been repeated often enough (approximately 60 times) and over a wide enough range of conditions to demonstrate their effectiveness. The commercial use of pyrrolidine alone or in combination with 2-aminopyridine on citrus, however, will have to await further studies on possible the color-added or the wax treatment.

Almost no rind injury was caused by pyrrolidine except at temperatures near 125°F; then it was severe. Mixtures of pyrrolidine and hexamine caused severe injuries at all temperatures. The only other compound causing rind injury was Dowicide A + hexamine; it produced a slight but slowly-developing injury on a few fruits.

Two types of wax were applied in packinghouse tests; namely, solvent wax and water-wax emulsion. Only the solvent waxed fruit previously treated with Dowicide A + hexamine lost its luster more rapidly than the untreated check.

No evidence was obtained that any of the compounds mentioned in this report affect the flavor of oranges.

SUMMARY

Pyrrolidine is an effective inhibitor of decay in Florida oranges. It is more effective than 2-aminopyridine against green mold rot but less effective against stem-end rot. A mixture of pyrrolidine and 2-aminopyridine is more effective against decay from all causes than is either applied separately. This combination gives promise of being more effective than the Dowicide A + hexamine mixture, particularly when the fruit is held for a long period. The addition of hexamine to pyrrolidine caused serious rind injury without effecting decay control.

CITRUS INSECT CONTROL FOR MARCH 1953

(Continued from page 4)

for scale and purple mite control. On Valencias the three quarts of oil affected the degreening slightly, but not as much as six quarts. A neutral copper can be used with the parathion-oil combination if desired.

Purple Mite and Six-spotted Mite Control: The same materials are recommended for control of both purple and six-spotted mite. Regardless of the miticide used, a thorough coverage of the under surfaces of the leaves is necessary for satisfactory six-spotted mite control. DN 111 can be used during the post-bloom period if the temperature does not go above 90°F. Ovotran or Orthotran at 1½ pounds per 100 gallons can be used at any time and have been more effective in warm weather than DN 111. As mentioned under Scale Control, an oil emulsion is very effective for purple mite control and is safe if applied when the average fruit size is not more than ½ inche in diameter.

Rust Mite Control: Many groves have not bee nsprayed or dusted with sulfur since late fall or early winter and in those groves rust mite infestations are likely to be heavy, so a sulfur application should be made as soon as possible to prevent early rust mite injury on the fruit. Rust mites usually increase very rapidly in the spring and to prevent injury and obtain a long period of control, the application should be made when no more

than 10 to 15 percent of the leaves are infested. Any of the sulfur compounds can be used during the post-bloom period. One gallon of lime-sulfur plus five pounds of wettable sulfur is a very effective spray in the spring. If no lime-sulfur is used, then increase the poundage of wettable sulfur to 8 to 10 pounds per 100 gallons. However, if wettable sulfur is combined with parathion and a very thorough application is made, 6 to 8 pounds is sufficient. Sulfur dust can also be used but it is not very effective during cool weather and should be used only to check heavy infestations until the grove can be sprayed. Good distribution of sulfur over all parts of the tree is as important for satisfactory rust mite control as is thorough coverage with a scalicide for scale control.

For more detailed information refer to the 1953 "Better Fruit Program" or consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

REVALUATING PALATABILITY IN FLORIDA CITRUS FRUITS

(Continued from page 6)

score of 70. As might be expected, the nomographs differed from each other because of the inherent characteristics of flavor and chemical composition of the different kinds of citrus fruits. The nomograph for round oranges is presented as figure 1.

The pattern formed by the various nomographs strongly suggested a consumer demand for round oranges, grapefruit, tangerines, and Temple oranges that were more mature and hence sweeter than those which passed minimum Florida maturity requirements prior to 1949. Standards were raised for round oranges, seedy and seedless grapefruit, tangerines, and Temple oranges by "The Florida Citrus Code of 1949." The results obtained by correlating the flavor or palatability with the chemical composition were used extensively in drawing up that part of the "Code" which dealt with the shipment of the fresh fruit.

Some of the data on Temple oranges (3, 4) were submitted to statistical analysis, in which a series of taste ratings were made on replicate samples of the same fruit. The judges repeated their ratings closely. Studies were then made to ascertain the variation among individual tasters. Differences were found, but not large ones. The definite association between palatability ratings and certain exact measurements indicates that the ratings are rather satisfactory in measuring quality. It is believed that the method used in the Department of Agriculture investigations permitted a fair approximation of the average consumer reaction.

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Entomologists In Hawaii Study Fruit Fly Hazard

Just where in the United States, and under what climatic conditions the destructive oriental fruit fly and related species could survive, is being determined in Hawaii through the cooperative research of entomologists of the U. S. Department of Agriculture and the University of California Agricultural Experiment Station. The entomologists are getting their results from six-foot square cabinets which accurately simulate the climate of most commercial fruit growing areas in the U. S.

Learning the climatic limits, and thus the potential importance of three major fly pests—the oriental fruit fly, the melon fly, and the Mediterannean fruit fly—should any one of them become established in the United States, is only one of many phases of extensive research designed to control these insects in Hawaii and keep them out of the U. S.

The oriential fruit fly, the entomologists point out, has become a major pest of most fruits and some vegetables grown in Hawaii since it first made its way to the Islands in 1944 or 1945 (probably in infested fruit from Saipan). The other two fruit pests, also in Hawaii, have been a constant threat to the mainland for more than 40 years.

A full year of observing how the oriental fruit fly reacts to simulated climates of six U. S. localities has shown the cooperating scientists that Fort Pierce, Fla., provides almost ideal weather for the reproduction and development of large populations of the fly.

Oriental fruit flies make the best headway at temperatures in the 65 to 80 degree range, with moderate to high humidities. Their development practically halts when temperatures average 57 degrees or lower. High temperatures and sudden temperature changes also affect the oriental fruit fly. Weather which simulated that of Fresno, Calif., with temperature above 100 degrees, killed an entire lot of 3,000 oriental fruit flies within a few minutes.

Vincannes, Ind., provided the least desirable climate of the six tested, allowing fruit fly development only in late spring, summer, and early fall. Of the other climates tested, winter conditions typical of Riverside, Oceanside, and Fresno, Calif., and Charleston, S. C., also prevented the development of the oriental fruit fly. In further studies now in progress, the effect of the climates of Auburn, San Jose and El Centro, Calif.; Orlando, Fla., and Houma, La., on the oriental fruit fly, the melon fly and the Mediterranean fruit fly, is being determined. The work is being conducted by Powers S. Messenger, University of California entomologist and N. E. Flitters of the USDA's Bureau of Entomology and Plant Quarantine. Both are stationed in Honolulu.

Temperatures and humidities in the cabinets change gradually from minute-to-minute, day-to-day, and season-to-season in duplicating the weather at any particular location. Five of the cabinets that simulate different U. S. climates are auto-

(Continued on page 17)

New Process Captures Fruit Flavors Used In Making Preserves

Aromas ordinarily lost in making fruit preserves can now be captured and returned to the preserves to enhance their fruit flavor or used to flavor other fruit products, the U. S. Department of Agriculture announced today.

These recovered flavors can be used to give a "natural" zest to beverages, fountain sirups, confectionery, ice cream and other desserts, according to Dr. G. E. Hilbert, chief of the Bureau of Agricultural and Industrial Chemistry. He describes the flavor recovery technique as a modification of a process devised by laboratory engineers for recovering volatile flavors from fruit juice. The new method was developed at the Bureau's Eastern Regional Research Laboratory in Philadelphia and has been adapted for commercial use in cooperation with a preserve manufacturer.

The new process merely involves changing the usual condenser arrangement on cooking kettles. By maintaining cooling water at a low temperature, the condensate contains practically all of the desired aroma. These captured flavors can then be concentrated to an essence and returned to the preserves or used to flavor other fruit products.

To avoid damaging flavor by overheating, preserves usually are made by cooking fruit, sugar, and other ingredients in a vacuum pan. However, many delicate flavors still escape during cooking. The new USDA technique avoids this, without appreciably changing the pressure-making process.

Details of the process, including information on costs and equipment may be obtained from the Bureau of Agricultural and Industrial Chemistry, USDA, Washington 25, D. C., or from the Eastern Regional Research Laboratory, Chestnut Hill Station, Phildelphia 18, Pa.

The research team which developed this new essence recovery process was composed of N. C. Aceto, R. K. Eskew, G. W. M. Phillips, C. S. Redfield, and J. J. Skalamera, all connected with the Bureau's Philadelphia laboratory.

ENTOMOLOGISTS IN HAWAII STUDY FRUIT FLY HAZARD

(Continued from page 16)

matically controlled through a range from 5 degrees F. below zero to 125 degrees F. Controlled humidity in these cabinets at above-freezing temperatures extends from 20 to 95 percent. The cabinet in which the Vincennes climate was duplicated also provides humidity controls at sub-freezing temperatures. A seventh cabinet simulates Hawaiian weather and thus provides the entomologists with a check of the accuracy of their findings.

The cabinets are much like walk-in refrigerators in appearance, and are fitted with both ultraviolet and infrared lamps to provide sunlike heat and light. Food, water, and the conditions necessary for normal development of the oriental fruit flies are also supplied in each of the cabinets.

Suit Against Citrus Mutual Falls Flat

Florida Citrus Mutual is devoting its full energies to several problems involving the current citrus marketing season, free for the first time in two months of any necessity of giving any attention to its fight against the Federal Trade Commission.

For all practical purposes, that fight is over. The trade commission's lawyers sent to Lakeland to take part in hearings on charges Mutual has violated anti-trust laws, have announced they will recommend that the charges be dismissed. It was considered a foregone conclusion the FTC would follow these recommendations.

L. C. Paulson, an FTC attorney, announced at the hearing that he and T. Harold Scott, the other government lawyer, would recommend dismissal. In a formal statement released at the same time, Paulson reported that from his further investigation of the citrus problem, "I am satisfied that Florida Citrus Mutual is a genuine growers' organization where the growers are making a sincere and worthwhile effort to solve their own problems and stabilize

(Continued on page 22)

The LYONIZER

Department

COMPILED BY THE LYONS FERTILIZER COMPANY

Reports Of Our Field Men . . .

SOUTHWEST FLORIDA
Eaves Allison

A heavy spring flush of growth is in evidence on all kinds of citrus at this time, Feb. 16th, accompanied by a good, healthy and apparently normal bloom—and at the proper time of year for good quality fruit. The continued cold snaps with cool nights in between are delaying opening of the bloom somewhat and also retarding maturity of the vegetative growth.

Low prices have knocked the tomato growers out of the market. More or less the same conditions exist in other vegetable crops. Bulb and flower growers are in the same boat. This has been anything but a good season for the farmer. It is lucky for the State in general that the citrus market looked up some this year. Otherwise the chorus of the blues would have been deafening!

NORTH CENTRAL FLORIDA
V. E. Bourland

Weather is very nice and cool after a good rain Saturday night. Mid-season oranges still being picked rapidly, prices now are very satisfactory to growers, but oranges have to be moved on account of dropping. Grapefruit still moving slowly. Most all trees are budding out with new growth, and it looks like there will be a good bloom.

PASCO AND HILLSBOROUGH COUNTIES
E. A. McCartney

It is now almost past the time to worry about cold weather. There is a good bloom in sight, and early grapefruit which is usually hard to see what buds and bloom are on the tree, are in most cases in heavy bud.

Every indication at this time is that there wil be a large crop. The rains recently have started the trees on their spring growth. Spring Top Dresser is being applied where an early fall application of fertilizer was made. The trend is to high nitrogen and less poundage and this is proving to be a good practice.

Grapefruit prices have not kept up with that of oranges and prices are still too low. Growers are hoping that this will change. Groves are looking good and healthy. There is very little brown leaf due to the use of Dolomite and Hi-Calcium Limestone and better fertilizer practices.

NORTH HILLSBOROUGH AND PINELLAS COUNTIES
J. A. Hoffman

A heavy amount of rainfall has been received in the past several months with some warm weather which has started numerous amounts of new growth and buds. The rains have been most beneficial to citrus growers but at the same time has been most harmful to melon growers that have planted in low ground causing the first planting to rot.

Fruit growers are taking advantage of the moist soil and now are applying the Spring application of fertilizer. Many groves have been harmed by purple mite and rust mite. In the next week or so spraying should be reduced to a minimum as some sprays along with pressure would be harmful to the new growth.

Practically all of the early and mid season fruit has been picked at this time and growers are expecting a bumper price for the late crop.

SOUTH POLK, HIGHLANDS, DESOTO AND HARDEE COUNTIES
C. R. Wingfield

February has been a month of high and low temperatures but there has been good moisture conditions. That is it has been good as far as the citrus is concerned, however the vegetable growers could have done with less. The soil at this writing, Feb. 16th, is still cold and seed has had a hard time germinating and growing off. Between this and rains it has been a slow start.

Citrus groves appear to be in good condition and are making every effort to put on a good bloom. The cold nights have held it back somewhat but with a few days of warm sunshine the trees will be in full bloom.

Where Top Dressers are being used the application has been completed. Most of the mid-season fruit in this section has been picked and some valencias. About the middle of February it appears that more Grapefruit were being picked with some going to fresh fruit and some to sectionized and juice.

WEST CENTRAL FLORIDA
J. E. Mickler

As in the rest of the Citrus territories, trees are pushing out new growth and bloom. Groves show the good treatment of an adequate fertilizer program, and well timed moisture conditions in this section have helped the overall picture. Most groves are showing heavy bloom, and the weather conditions will determine soon what will happen if frost comes once more this early Spring to hamper ample setting of fruit.

Spring applications of Top Dressers have been going on, and will soon wind up.

HIGHLANDS AND POLK COUNTIES
J. T. Griffiths and J. K. Enzor, Jr.

Rains have continued, and with warm weather many groves will be in full bloom by March 1. In the middle of February, indications are that there will be a good bloom in most groves.

Spring applications of Top Dresser will have been applied in most groves by March 1, and post-bloom spray operations will probably be starting in some groves in early March.

Six-spotted mites are showing up in a number of groves. It is quite possible that these will be a problem, particularly in grapefruit groves which did not receive a thorough DN or Lime Sulfur spray in January or February. This mite can cause severe injury and groves should be carefully checked for it.

General leaf drop is occurring in many groves, particularly on grapefruit. In most instances this seems to be accompanied by a good flush of spring growth, and although, greasy spot is present, the drop should be considered as normal in most all instances.

Parathion Can Be Used Safely

CHARLES R. STEARNS, JR., AND
W. L. THOMPSON
FLORIDA CITRUS EXPERIMENT
STATION, LAKE ALFRED

With the post-bloom spray period approaching many growers are planning on using parathion for the control of scale insects. Parathion can be used safely only if directions and precautions are carried out. If supervisors and spray labor are not willing to carry out all precautions parathion should not be used.

Observations made by field and research men this past fall and winter showed that all precautions for handling and spraying parathion were not being taken by spray labor. Investigations indicated that in some cases proper protective devices were not furnished spray labor while in other cases the person in charge of the spray operation was lax in his supervision of the men. Where the precautions have not been continuously adhered to, illnesses caused by parathion have occurred.

Recent medical work has shown that it is best to have a pre-exposure blood test made. This blood test in addition to showing cholinesterase levels will also show whether a person is anemic or has a malfunctioning liver in which case either condition might make the individual more susceptible to illness from parathion. It is suggested that blood tests be made every 7 to 10 days as long as the individual is using parathion.

Blood tests are essential in diagnosing parathion illness properly because many of the symptoms of parathion poisoning occur with many other illnesses. Whenever an individual becomes ill while working with parathion he should be taken to a doctor or hospital and a blood test should be made promptly after emergency treatment. If parathion was the cause of the illness the individual should not go back and use parathion until blood tests show that the cholinesterase levels in the blood are normal.

Persons in charge of the spray operations should thoroughly understand all the precautions necessary when parathion is to be used and rigidly enforce them. These precautions are outlined in the **1953 Spray and Dust Schedule** and are reprinted below.

PRECAUTIONS WHEN USING PARATHION

Men who will use parathion 10 days or longer should receive blood tests before starting work and at 10-day intervals thereafter, as long as they continue to work with it. In case of suspected parathion poisoning, blood tests are necessary for reliable diagnosis.

Wear an effective chemical cartridge respirator such as made by the Willson Co. or Mine Safety Appliance Co. Change paper filters daily and cartridges once a week. Make sure mask does not leak about nose or cheeks.

Change to clean clothing each day, or oftener if garments are wet with spray. Wear long sleeves, a washable rain hat and **natural** rubber boots and gloves. Do not use leather or canvas.

A tractor canopy affords protection for the operator. Where canopies are not practical, a raincoat or poncho will protect driver from spray drift. When spraying, work into the wind when possible.

Wash hands before eating or smoking. Take a thorough bath as soon as the work day is finished.

When mixing parathion, stand so the wind will blow dust away from the men and cut open packages with a knife. Either make a slurry with wettable powder in a 5 gal. can; or if parathion is to be mixed directly into tank, have tank almost full, with agitator running, and introduce parathion on the surface of the water.

Burn or bury all empty parathion containers. Wash spray equipment every day to avoid hazardous accumulations.

Although there appears to be little danger in walking through a grove that has just been sprayed with parathion, it is recommended that people stay out of a grove for at least four days after spraying. Operations involving contact with

(Continued on page 22)

Some Varietal Responses of Florida Oranges To Pre-Harvest Sprays[1]

In some seasons a high percentage of the total crop is lost through pre-harvest drop. Losses are rarely less than 15 percent and frequently may amount to as much as 30 percent of the total crop. The economic loss to the grower is frequently greater than is generally realized. Mid-season varieties receive the greatest amount of condemnation because they particularly shed heavily during periods of warm, dry weather in the fall and winter. Although pre-harvest drop of Valencia oranges is just as great as that of Pineapple and seedling sweet oranges, the Valencia variety escapes the reputation of being a bad dropper because the drop extends over a long period. Rapid decay of fallen fruit and also the covering up of such fruit from time to time by disking hide the magnitude of the loss from the grower.

In recent years this problem has been attacked by a number of workers. Gardner (2) reported in 1941 that naphthaleneacetic acid and naphethalene acetamide could be used to lessen materially the drop of Pineapple oranges in Florida, but the high concentration and the necessity of early application discouraged use of the method. In 1947 Stewart and Klotz (4) showed that by spraying California Valencia orange trees in May with a 2,4-D derivative (diethanolammonium 2,4-dichlorophehoxy-acetate) at a concentration of 25 p.p.m., as much as 78 percent of the normal pre-harvest drop could be prevented.

Study of the problem under Florida conditions was resumed in 1948 by Gardner, Reece, and Horanic (3), using the sodium salt of 2,4-D and four other growth-regulating compounds. They reported that the response of Pineapple oranges to 2,4-D closely paralleled the results reported for California Valencias. However, they found that the compound seemed to be without effect upon Florida Valencia oranges when applied on Oct. 15, 1948 and on Dec. 19, 1949. The marked contradiction by these results of those reported from California for this variety led to further experiments.

The experiments in 1950 were designed to test the effect of the time of application of 2,4-D upon pre-harvest drop of Valencia oranges. All sprayed trees were drenched with the sodium salt of 2,4-D applied at a concentration of 25 p.p.m. of 2,4-D acid equivalent. Trees were chosen in blocks for their comparable size and crop. Blocks were replicated twenty-five times. Within each block treatments were applied to single-tree plots as follows: (1) Unsprayed tree—control; (2) tree sprayed September 12 and again April 16; and (3) tree sprayed September 12 and again on January 29. All litter beneath the trees was removed at the time the sprays were applied. Weekly drop records were kept thereafter until the crop was

(Continued on page 22)

1. Authors: Philip C. Reece, associate botanist, and George E. Horanic, biological science aid, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture, at Meeting Florida State Horticultural Society.

Table 1. Effect of time of application of 25 p.p.m. 2,4-D on pre-harvest drop of Valencia oranges picked May 14, 1951

Date spray applied	Ave. no. boxes per tree	Percent of total crop dropped	Percent increases in drop of sprayed fruit
Control—no spray	8.0	21.8	
Sept. 12 and Apr. 16	7.6	25.2*	+ 15.6
Sept. 12 and Jan. 29	6.9	30.0**	+ 37.6

*Statistically significant—
Required difference between means, 3.2 percentage units
**Statistically highly significant—
Required difference between means, 4.2 percentage units

Table 2. The effect of mid-winter application of 25 p.p.m. of 2,4-D (sodium salt) on pre-harvest drop of Valencia oranges picked May 14, 1951

Date spray applied	Percent of total crop dropped	Percent increase in drop of sprayed fruit
Control—no spray	9.7	
Sprayed Jan. 29	16.4**	69.1

**Statistically highly significant.
Required difference between means, 1.7 percentage units

SOME VARIETAL RESPONSES OF FLORIDA ORANGES TO PRE-HARBEST SPRAYS

(Continued from page 21)

harvested.

The data in Table 1 show that trees in the control plots lost 21.8% of their total crop by pre-harvest drop. However, trees that received applications of 2,4-D in September and January lost 30% of their total crop, a loss of 37.6% more than that of the controls instead of the expected decrease. The loss of fruit from plots sprayed in September and April was also greater than that from unsprayed plots.

No apparent difference could be detected in the drop records from these plots before the second 2,4-D spray was applied. Therefore, in an analysis of the effect of the January 29 application, prior drop records were disregarded and the total crop was recalculated on the basis of subsequent drop records plus the picking yield. Each experimental block then consisted of paired trees, one sprayed and one unsprayed and blocks were replicated 25 times.

Table 3. Effect of spring application of 25 p.p.m. 2,4-D on pre-harvest drop of Valencia oranges picked May 14, 1951

Date spray applied	Percent of total crop dropped	Percent increase in drop of sprayed fruit
Control—no spray	4.9	
Sprayed Apr. 16	6.6**	34.7

**Statistically highly significant. Required difference between means, 1.1 percentage units

Table 4. Effect of applying 25 p.p.m. of growth regulators Dec. 21, 1951, on pre-harvest drop of Pineapple oranges picked Feb. 21, 1952

Spray	Percent of total crop dropped	Percentage of normal drop prevented
None	9.3	
Sodium salt of 2,4-D	8.1*	12.9
Triethanolamine 2,4,5 T-P	7.7**	17.2
Diethanolamine a,4-D	7.5**	19.4

* Statistically significant—
Required difference between means, 1.07 percentage units
**Statistically highly significant—
Required difference between means, 1.2 percentage units

Table 5. Effect of applying 2,4-D (sodium salt) Dec. 14, 1951, on pre-harvest drop of Temple oranges picked Feb. 9, 1952

Spray treatments	Percent of total crop dropped	Percent of normal drop prevented
None	10.6	
25 p.p.m. 2,4-D	7.7**	27
50 p.p.m. 2,4-D	6.9**	35

**Statistically highly significant. Required difference between means, 1.6 percentage units

Data in table 2 show that between the date of spraying, January 29, and picking date, May 14, the trees that had been sprayed with 25 p.p.m of 2,4-D lost 16.4% of their total crop. Comparable Table 2—The effect of mid-winter.... unsprayed trees lost 9.7%. Thus the use of 2,4-D on Valencia oranges proved decidedly advantageous as it increased the normal loss by 69.1%.

The effect of the 2,4-D spray applied at the rate of 25 p.p.m. on April 16 was similarly analyzed. The data in table 3 show that between that time and the picking date unsprayed trees lost only 4.9% of their crop, while sprayed trees lost 6.6%. Thus this spray treatment increased the normal loss over a four-week period by 34.7%. In this experiment the time of spraying, April 16, corresponded closely with the effective period indicated in the California experiments for Valencia but it is quite clear that the results were the opposite of those reported by the California investigators.

(Concluded next issue)

SUIT AGAINST CITRUS MUTUAL FALLS FLAT

(Continued from page 17)

the industry.

"It is not the purpose of the Federal Trade Commission to interfere with but rather encourage such efforts so long as they are within the basic law. It is my personal view that the best solution is found through cooperative effort.

"If the present laws are insufficient, they should be strengthened. Certainly the citrus industry, which means so much to the economy of Florida and the welfare of the entire country, deserves the most intelligent, practical and sympathic consideration possible."

Mutual's president said that the fact the FTC lawyers are willing to recommend that the proceedings be dismissed "indicates they believe Mutual is not violating any laws of the United States but, on the contrary, is serving and accomplishing many worthwhile projects for its grower members and the citrus industry of Florida."

He said he was "particularly pleased" at Paulson's statement because it reflects an opinion "based on a thorough investigation of Mutual and is sufficient to satisfy everyone that Mutual is doing the best possible job for its members."

PARATHION CAN BE USED SAFELY

(Continued from page 20)

the tree, such as pruning or picking, should not be carried out within 14 days after spraying. Groves sprayed with parathion should be posted with warning signs.

Classified Ads

Vitamin P Now In Commercial Production

Vitamin P from citrus, first made public through the medium of this publication, is now available to the medical profession after four years of intensive clinical investigation in which 98 hospitals took part, Dr. Ludd M. Spivey, President of Florida Southern College, announced recently.

Dr. Boris Sokoloff, director of the Bio-Research Laboratory at the College, who initiated the Vitamin P investigation six years ago, said that the substance is recommended in all conditions when small blood vessels are out of order and when there is danger of abnormal bleeding.

"In our clinical investigation," Dr. Sokoloff reported, "Vitamin P was proved to be of value in the prevention of stroke and other internal bleedings which often occur in high blood pressure.

"For this reason, it is prescribed for persons affected with high blood pressure as a preventive against any possible dangerous complications. In hemophilia, and other blood diseases when abnormal bleeding is present, this vitamin arrests bleeding promptly.

In the X-ray treatment of cancer patients when so-called radiation burns often occur, CVP (citrus Vitamin P), presents them."

During his investigative work at the Bio-Research Leboratory, Dr. Sokoloff and his associates presented 15 scientific reports about the therapeutic value of Vitamin P, which is extracted from citrus waste.

The Pasco Packing Company, of Dade City, the world's largest citrus processor, became interested in the development at Florida Southern and built a plant which produces the substance in volume. The U. S. Vitamin Corporation, of New York City, is in charge of distribution and sales and thousands of physicians throughout the nation are prescribing CVP.

Source of the vitamin is citrus molasses. When faced with the problem of finding a method to extract the substance at low cost and in pure form from citrus waste, the Florida Southern researcher determined that molasses was a rich source and he then perfected a method of extracting CVP and still leaving the molasses itself for cattle feed.

In other words, the raw material costs nothing and yet about 30 pounds of Vitamin P are extracted from a ton of molasses.

Dr. Sokoloff said that this year more than 100,000 pounds of this valuable substance will be extracted from citrus waste and used by the people of the United States.

The Florida Southern scientist was formerly associated with the Pasteur Institute in Paris, the Rockefeller Institute for Medical Research in New York, and Columbia University. He is the author of 17 books, ineluding "Cancer: New Approaches and New Hope," "Miracle Drugs," and "The Story of Penicillin."

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may be mixed with nitrogen, potash, and magnesium. Where deficiency is severe include sufficient Ferro-grene for one half pound per tree. See table below.

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Amounts of Ferro-grene per ton for severe deficiency

Lbs. of fertilizer per tree	No. trees to be fertilized with one ton	Lbs. of Ferro-grene per ton
10	200	100
15	133	67
20	100	50
25	80	40
30	67	34

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